



## MID-TERM EXAM 2012/2013

Course	Energy Conversion (EPM2106)	Time	60 minutes
Students	2nd Year (Electrical Power and Machines)	Mark	25

Answer ALL the following questions:

- Clarify your answer with the suitable sketches as you can.
- Assume any missed data reasonably.

**The first question** (6 marks)

Which of the following statements is correct? You can write down in your answer sheet the question number followed by either ✓ or X mark.

1.	Inductance of a coil increases with increase in magnetic reluctance of its core.
2.	For a linear magnetic system, coil inductance does not depend on its current
3.	Mutual inductance between two coils depends on their self inductances
4.	For linear magnetic system stored energy equals co-energy.
5.	Direction of electromagnetic torque is to increase inductance
6.	Transformer voltage depends on coil inductance variation with position.

**The second question** (12 marks)

1.	For a singly-excited rotating electromechanical energy converter, derive a relation for the developed torque in terms of co-energy. (3 mark)
2.	Derive a general expression for the electromagnetic torque acting on the rotor of an AC doubly-excited device. The device has a cylindrical stator and a salient-pole rotor. Then show how this device can be used as a synchronous machine. (6 mark)
	With the aid of BH curve of a permanent magnet material show: a) the effect of air gap length on the position of the operation point b) the point of maximum energy product (3 marks)

**The third question** (7 marks)

	An iron ring has a cross-section of 5 cm <sup>2</sup> , and a mean diameter of 30 cm. An air-gap of 0.5 mm has been cut across the section. The ring is wound with a coil of 300 turns through which a current of 2 A is passed. If the total magnetic flux is 0.4 mWb, find the relative permeability of the iron. Neglect both magnetic leakage and fringing. (3 marks)
	An electromagnet of 5 cm <sup>2</sup> cross section area and 1000 turns coil is used to control a relay. The magnet has an air gap length of g. Assume that the reluctance of the iron parts is negligible. For a range of g from 1 to 5 mm, it is required to develop a fixed force of 50 N. As a function of g, plot the required current and stored energy variations (4 marks)